



CN Mile Point 197.4, Rivers Subdivision

Project Update

*Southeast of St. Lazare, Manitoba*

November 7, 2019

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## **SUMMARY: CN MP 197.4, RIVERS SUBDIVISION - ENVIRONMENTAL SITE ASSESSMENT AND FISH SALVAGE**

The following information summarizes the Environmental Site Assessment (ESA) and fish salvage activities at CN Mile 197.4 on the Rivers Subdivision near St. Lazare, Manitoba (the Site) from the initial response to October 31, 2019.

### **EVENT AND SITE DESCRIPTION**

At approximately 02:45 on February 16, 2019, a CN freight train derailed at Mile 197.4 of the Rivers Subdivision, located immediately east of an oxbow of the Assiniboine River. A total of 34 cars derailed on-Site, all of which were carrying Cold Lake Dilbit Blend (CLB), and of the 34 cars, 13 cars were ruptured and released approximately 820,000 liters of CLB.

The Site is located approximately 11 km to the south/southeast of St. Lazare, Manitoba. The lands surrounding the Site, beyond the CN Right-of-Way (ROW), are primarily improved pasture owned by a single landowner along with an oxbow on the west side of the rail line. The Assiniboine River mirrors this alignment, approximately 850 m to the west.

From this point forward, directions referenced are in relation to standard railroad practice, which is consistent with nomenclature that has been in place at the Site during the response to date. Site directions herein are based on the convention that the rail line runs east-west and Site north corresponds approximately to true east.

### **SUMMARY OF ACTIVITIES COMPLETED TO DATE**

The immediate emergency response focused on containing the released product visible on the ice and snow of the oxbow. Isolation was achieved through constructing two temporary berms on either side of the visible limits of product sitting on the oxbow. These berms remained in place to provide a confined monitoring area, hereafter referred to as the Oxbow Monitoring Area (OMA).

Impacted soils, water, ice and free product were primarily removed from the Site during the emergency response, focusing on areas between the CN track and the oxbow. Impacted sediments were also removed from the base of the oxbow between the two temporary containment berms.

An intrusive investigation to characterize and delineate remaining impacted soils was completed in May 2019 followed by a subsequent remedial excavation for source removal of product remaining within the sub ballast material of the rail bed completed in June 2019.

The following activities have been conducted at the Site to October 31, 2019:

- Site inspections;
- Location and elevations surveys;
- Ongoing surface water monitoring and sampling;
- Initial response and Site remediation including the removal of impacted soils, water, ice and free product;

- Intrusive investigation within the CN rail bed;
- Excavation of residual, accessible soil exceedances;
- Source removal below the CN rail bed;
- Polycyclic aromatic hydrocarbon (PAH) soil sampling;
- Pathway evaluation and risk assessment;
- Summer fish salvage;
- In-situ water quality monitoring and documenting observations of fish;
- Response to Third Party concern on observed sheen; and
- Fall fish salvage.

## FIELD METHODS

### Site Inspections

Weekly, bi-weekly and monthly Site inspections have been conducted at the Site to the end of October 2019. Site inspections included but were not limited to:

- collecting drone imagery;
- checking equipment maintained on-Site;
- documenting wildlife sightings;
- inspecting the CN ROW and berms;
- observing surface water in the oxbow inside and beyond the berms;
- inspecting and repairing, as required, erosion and sediment controls;
- monitoring in-situ surface water quality;
- collecting surface water and groundwater samples;
- cleaning the seepage inside of the east culvert; and
- removing residual product observed on the ground surface for off-Site disposal.

### Location and Elevation Surveys

Assessment and sampling locations have been surveyed using a Real Time Kinematic (RTK) survey by KGS Group Consulting Engineers (KGS) since the initial response including the survey of the monitoring well locations to assist in establishing the local ground and groundwater elevations.

### Surface Water

Subsequent to the initial response and remediation, monitoring and inspections were undertaken beginning on March 18, 2019. The timeline encompasses the post-freshet conditions and included three site visits each week to complete the following tasks:

PROJECT TASK(S)	RESPONSIBLE PARTY	SCHEDULE
Monitoring for aquatic life, in-situ water quality and imagery/drone flyovers	HDR/Matrix	Weekly Mondays
Analytical surface water sampling and imagery/drone flyovers	KGS	Weekly Wednesdays
Maintenance of Erosion Controls and/or Booms	Tervita	Weekly Fridays

Monitoring transitioned to one inspection per week on April 19, 2019 with in-situ water quality monitoring and surface water sampling completed on alternating weeks by HDR/Matrix and KGS, respectively. A transition to monthly monitoring and surface water sampling was completed following the source removal below the CN rail bed and surface water and groundwater sample collection on June 26, 2019.

Analytical surface water quality data has been collected from upstream and downstream of the Site, and within the oxbow monitoring area from March 20, 2019 to the most recent monthly sampling conducted on October 30, 2019. The next surface and groundwater sampling event is scheduled for November 13, 2019.

In-situ water quality parameters including temperature, pH, electrical conductivity (EC) and dissolved oxygen DO were measured at five locations within and beyond the monitoring area, as well as at individual surface water sampling locations using a YSI multimeter. Samples have been analyzed for BTEX, PHC Fractions F1 to F4, PAHs, routine water quality parameters and total metals.

### **Initial Response and Soil Sampling**

Initial recovery of the CLB was completed in stages: snow and ice removal, removal of trees and woody debris and impacted soils within the vicinity of the recovered product. As part of this process, the ice cover on the oxbow between the constructed containment berms was broken to facilitate removal of residual CLB impacts within ice fractures and to excavate any impacted sediment. The initial extents of this bulk recovery program were determined by aerial imagery. Removal of the CLB was undertaken by:

- Constructing three containment berms (one berm removed and two remaining after the demobilization for freshet on March 18, 2019);
- Employing vacuum trucks and tracked excavators;
- Constructing lined containment cells for staging of impacted material awaiting transfer for off-Site disposal; and
- Removing rail, structural and fencing debris.

Bulk removal of CLB impacted soils was based on visual staining. All impacted soils were removed from third party and CN-owned lands with the following exceptions:

- Impacted soils within the rail bed and in close proximity of the rail line that CN's on-Site geotechnical subcontractor determined could not be removed without affecting the stability and safe operation of the rail line;
- Impacted soils in culvert areas that required immediate backfilling to maintain stability and the safe operation of the rail line; and
- Marginal exceedances within the oxbow that could not be removed safely due to groundwater infiltration and associated saturated ground conditions.

The soil samples were submitted for analysis of BTEX, PHC Fractions F1 to F4, and select samples for salinity. Following removal of soil impacts, impacted lands were backfilled, graded and re-contoured.

### **Intrusive Investigation – Borehole Drilling and Soil Sample Collection**

A total of 24 boreholes (BH19-1 to BH19-18 and MW19-1 to MW19-6) were drilled from May 1 to

May 7, 2019. The boreholes were advanced using a track mounted drill rig equipped with 0.2 m (8 inch) diameter hollow stem augers, continuous core barrels and split spoon sampling equipment. The boreholes were advanced with the purpose of delineating the extent of the CLB contamination below the railbed. Directional boreholes were advanced as follows: 11 locations on the south embankment and two locations on the north embankment, to investigation the track bed. The directional boreholes were completed at angles the ranging from 19 to 49 degrees from horizontal and advanced to vertical depths between 1.5 to 8.8 m below ground surface (mbgs). Three vertical boreholes were completed from the top of the rail bed to delineate observed impacts in directional borehole BH19-1 and were advanced to 3 mbgs. Ten vertical boreholes were advanced ranging in depths between 5.7 to 8.8 mbgs, six of the boreholes were completed with monitoring wells.

Directional boreholes were backfilled with a bentonite slurry from the bottom of the borehole using a tremmie pipe with the exception of BH19-14 and BH19-15 that were backfilled through the auger casings with coated bentonite pellets and bentonite chips due to the close proximity to the rail line. Boreholes drilled from the top of the track bed were backfilled with bentonite chips.

Soil samples were collected at regular intervals or where the soil lithology changed. Soil conditions were recorded on standard borehole logs along with field observations (i.e., odours, staining). The soil was logged consistently with the Unified Soil Classification System. Each soil sample was split into two sub-samples. One of the sub-samples was placed into laboratory supplied sample jars and placed into a chilled cooler for potential chemical analysis. The second sub-sample was placed into a laboratory-supplied re-sealable plastic bag for measurement of soil vapour concentrations. Vapour concentrations were measured in the soil samples using a RKI Eagle II calibrated to hexane.

Based on field observations (i.e., visible contamination), depth of samples, and the results of soil vapour screening, soil samples were placed in laboratory-supplied glass jars for potential chemical analysis of Grain size, BTEX, PHC Fraction F1 to F4 and PAHs.

### **Monitoring Well Installation**

Groundwater monitoring wells were installed in six of the boreholes (MW19-1 through MW19-6) ranging in depths from 6.6 to 8.8 mbgs. The monitoring wells were constructed of 50 mm diameter, Schedule 40 polyvinyl chloride (PVC) screen and solid casing. All monitoring wells included a screen between 2.1 and 3.1 m of 0.010" slot screen and solid riser from the screen to surface. The well annulus surrounding the screen was backfilled with 10/20 silica filter sand. Above the sand pack, the annulus was backfilled with hydrated bentonite chips to surface. The well screen and casing connections were threaded, and no glues or solvents were used in the construction of the monitoring wells. All monitoring wells were completed with locked aboveground metal protective casings.

### **Groundwater Monitoring and Sampling**

Monitoring wells were monitored for depth to groundwater, total well depth and thickness of light and dense non-aqueous phase liquids (if present). In order to prevent cross-contamination, the interface probe was washed with lab-grade detergent (Liquinox) and rinsed with de-ionized water between monitoring wells. As part of groundwater monitoring, organic vapour concentrations within the well annulus were measured using and RKI Eagle II calibrated to hexane.

Approximately two weeks following installation, the monitoring wells were developed with dedicated disposable bailers. The static water column was measured and the well volume was calculated. Each well was developed until one of the following conditions was met: purged water was visibly clear of sediment and at least three well volumes (i.e., casing volume + filter pack volume) had been removed; or, until the well went dry. If a monitoring well went dry, the well was allowed to recover prior to collecting a sample.

Where water yields were sufficient, monitoring wells were sampled with dedicated disposable bailers. During purging field parameters (temperature, pH, EC and DO) were measured every well volume using an YSI multimeter. Samples were collected when field parameters became stable (i.e., within 10%) and at least three well volumes were purged. All probes and meters were cleaned between each location to minimize cross contamination. Where consumable items were required, such as a bailer, it was dedicated to the sample location.

Analytical groundwater water quality data has been collected from the monitoring wells from May 29, 2019 to the most recent monthly sampling conducted on October 30, 2019. The next groundwater sampling event is scheduled for November 13, 2019. Samples have been analyzed for BTEX, PHC Fractions F1 to F4, PAHs, routine water quality parameters and dissolved metals. Well purge water was drummed and temporarily stored on-Site and later disposed off-Site.

### **Source Removal**

On June 2, 2019, previous soil exceedances identified by laboratory results on the landowner's property located along the south side of the CN ROW adjacent to the fence line were excavated.

Between June 4 and 6, 2019, two excavations and two slot trenches were established in order to complete source removal within the CN rail bed. Residual CLB observed within the granular subballast material was removed. The base and walls of the two remedial excavations were sampled on an approximate 5 m by 10 m grid.

A total volume of approximately 1,507 m<sup>3</sup> of soil was removed from the excavation areas on the south side of the rail line, EX1, EX2, Slot1 and Slot2 for off-Site disposal as non-hazardous waste at the Virden Landfill.

### **PAH soil sampling**

An additional PAH soil sampling program was conducted on June 9, 2019, and samples were collected from the CN ROW south of the rail line and the oxbow monitoring area. At each sampling location, two soil samples were collected; one from the surface and one from surface to 0.15 mbgs using a shovel. Samples were submitted to BV Laboratories in Winnipeg, MB, for analysis of PAH.

### **Background Soil Sampling**

A background PAH soil sampling program was conducted on June 9, 2019, to determine the chemical characteristics of the native soils in the vicinity of the Site. Six background locations (BG-1 through BG-6) were selected from areas beyond where Site activities occurred. At each sampling location, two soil samples were collected; one from the surface and one from surface to 0.15 mbgs using a shovel and were submitted for analysis of PAHs.

## Pathway Evaluation and Risk Assessment

An initial evaluation of the potential risk to human health and the environment related to the presence of PAHs in selected areas at the Site has been completed. The final, detailed assessment will be included as part of the Environmental Site Assessment (ESA) being prepared for the Site.

The Human Health and Ecological Risk Assessments evaluate the potential risks based on the presence and concentrations of incident-related chemicals of concern (COCs), potential COC toxicity, the receptors that may be exposed, and the exposure scenarios under which receptors may come into contact with COCs.

Risk assessments are typically conservative, as they incorporate assumptions that likely overestimate the potential for human health and ecological exposure and risks. For this effort, conservative assumptions have been chosen whenever indicated by applicable guidelines.

The Human Health Risk Assessment was performed in accordance with *Health Canada Part I and V: Guidance on Human Health Preliminary/Detailed Quantitative Risk Assessment (PQRA/DQRA)* Version 2.0 (Health Canada 2010; 2012), the *Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health – Polycyclic Aromatic Hydrocarbons* (2010) and other guidance as appropriate. It was determined that there were sufficient data available to develop many of the components of a Detailed Quantitative Risk Assessment (DQRA). This provides a more detailed and site-specific evaluation of potential risks than a Project Quantitative Risk Assessment (PQRA) in that it uses actual sample data, rather than modeling results.

The ecological risk assessment has been completed in accordance with Canadian Council of Ministers of the Environment (CCME) guidelines, as provided in *A Framework for Ecological Risk Assessment: General Guidance* (CCME, 1996; 1997), supplemented primarily by the *Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health – Polycyclic Aromatic Hydrocarbons* (CCME, 2010) and guidance from the Federal Contaminated Sites Action Plan (Health Canada, 2012). Other relevant guidance was used as appropriate. A Screening Assessment has been prepared, consisting of the calculation of PAH-specific Hazard Quotients (HQs), which represent the ratio of COC concentrations detected at the Site vs. available ecological guidelines.

Based on the initial risk assessment, a total of 36 locations (14 locations within vicinity of the oxbow monitoring area, 18 locations within the CN ROW and 4 locations on the north side of the rail line between the CN ROW and the public road allowance) were identified for further sampling and assessment for human health risk and ecological screening assessment. Re-sampling of these locations was completed during the week October 14, 2019, to further evaluate potential risks, and to determine if natural attenuation would be recommended as a management strategy for residual PAH at the Site.

The 36 locations were located by a KGS surveyor and resampled for analysis of PAHs. Laboratory analysis identified four remaining regulatory exceedances. These exceedances are considered to represent negligible risk and would likely be acceptable for regulatory closure. However, due to Third Party concerns, the three locations that are located within the OMA and/or flood zone will be excavated and resampled during the in-stream berm removal. The fourth location is within the CN ROW at a depth of 1 mbgs and posed no risk to surface water or sediments within the oxbow.

## **Initial Fish Salvage**

During a July 4, 2019 site visit, CN and HDR representatives observed small-bodied fish in the OMA. The determination was made these fish should be moved into deeper waters to help prevent possible fish mortalities associated with warm summer temperatures and anticipated declines in dissolved oxygen (DO) levels.

On July 24, 2019, approximately 925 fish were relocated. Note that water levels observed on July 24, 2019 were higher than levels observed on July 4, 2019, reflective of recent rainfall. The DO reading in seine area 1 was 11.4 mg/l and 134% saturation. Water temperature was 24.4 degrees Celsius. In seine area 2, the water temperature was the same as seine area 1 and DO was 13.6 mg/l with 173.2% saturation.

As part of the program, it was determined that a mesh barrier should be put in-place to avoid fish re-entering the shallower areas of fish capture by confining fish to deep pools onsite. An attached Site sketch illustrates the location of the mesh barrier.

The open water portions of the OMA (seine net site 1 and 2) were fished using seine nets to capture, extract, ID and estimate fish numbers. These areas were netted three times over a period of three hours. Salvaged fish were placed in an insulated bucket and the water was oxygenated with a battery operated aeration bubbler. All fish were released to the deep water near the south berm. No mortalities occurred between capture and release, and no federal Species at Risk Act (SARA) listed fish species were encountered.

## **In-situ Water Quality Monitoring and Documenting Observations of Fish**

Weekly monitoring of DO levels within the OMA between the two in-stream berms has been conducted since July 24, 2019. DO has been monitored to ensure remaining fish were not at risk of potential mortality from low DO concentrations.

## **Response to Third Party Concern on Observed Sheen**

On October 18, 2019, it was reported to CN that there was a potential oil sheen observed within the OMA. A crew immediately mobilized to the Site to assess the area of concern. The initial inspection of the south berm inside of the OMA did not identify a sheen; however, bubbles were identified coming from the bottom of the monitoring area to surface, and a surface water sample was collected at this location.

After collection of the initial sample, a faint sheen roughly 0.6 m by 1.5 m in area was observed on the surface of the water within the same area that the bubbles had been observed. The sheen was assessed by observing its behavior when attempting to break it; the sheen did not break into platelets and instead appeared to slowly reform back together. Based on the observed characteristics of the sheen, there was potential for the sheen to be a result of hydrocarbons, although there was no rainbow appearance and no odour. A second surface water sample was collected that included the observed sheen to verify surface water quality through laboratory analysis of hydrocarbons.

The sediments along the shore of the south berm were agitated using the stick. A small globule was observed rising to the surface of the water. Once the globule reached the surface, it appeared to bloom outwards creating a halo-like affect; although there was no rainbow appearance to the sheen and no odour. A third surface water sample was collected at this area observation.

The shores of the monitoring area were also assessed, with extra attention focused on observing conditions within the cattail reeds, as the wind was blowing in that direction. No sheen was identified within the reeds. An organic sheen previously identified in the October 17<sup>th</sup> update was identified along the shores of the south embankment; however, no other sheens were identified.

Additional samples were collected for laboratory analysis on Monday, October 21, 2019. Samples collected on October 18 and 21, 2019 were transported to Bureau Veritas Laboratories in Winnipeg, Manitoba for analysis on emergency turnaround time. Surface water samples collected on October 18 and 21, 2019 were analyzed for benzene, toluene, ethylbenzene and xylenes (BTEX) and petroleum hydrocarbon (PHC) Fractions F1 through F4 along with polycyclic aromatic hydrocarbons (PAHs). Analytical results are included as Appendix A.

The results for all samples analyzed on October 18 and 21, 2019 were below the laboratory detection limits. As no hydrocarbons were detected through laboratory analysis of samples collected directly from the observed sheens on-Site. The sheens observed on October 18, 2019 were considered naturally occurring and unrelated to the CLB release.

### Subsequent Fish Salvage

Due to seasonally declining temperatures, and reflective of the *Fisheries Act* (Section 34.4), the team conducted fish salvage at the OMA in October 2019 ahead of winter freeze-up. CN took action in a collaborative effort with Manitoba Sustainable Development (MSD) to conduct fish salvage during the week of October 21, 2019, with subsequent minnow trapping into early November 2019.

MSD provided one staff person and an electro-fishing boat to assist CN with the fish salvage, and to relocate salvaged fish from the OMA directly to the Assiniboine River. CN in turn assisted MSD with the use of the helicopter to sling the boat into the OMA to complete electro-fishing.

Taiga Helicopters was subcontracted to provide the helicopter, a helicopter pilot and one ground person. The ground person assisted directly in slinging the electro-fishing boat and moving fish from the coolers to the water bucket.

Following the collaborative fish salvage effort by all parties involved with MSD during the week of October 21, 2019, minnow traps were deployed overnight on October 24, 29, 30 and 31. A total of 6,096 fish were removed from the OMA and relocated to the Assiniboine River mainstem in St. Lazare, with no Species at Risk captured.

## ASSESSMENT GUIDELINE FRAMEWORK

The Contaminated Sites Remediation Regulation administered by MSD specifies standards to be applied to contaminated sites in Manitoba as follows:

1.1(2) For the purpose of clause 3.1(a) of the Act, the following standards are adopted, as amended from time to time:

### Primary standards

- Canadian Council of Ministers of the Environment, Canadian Environmental Quality Guidelines, 1999

- Canadian Council of Ministers of the Environment, Canada-Wide Standards for Petroleum Hydrocarbons (PHC) in Soil, 2008
- Health Canada, Guidelines for Canadian Drinking Water Quality — Summary Table, 2012

#### Secondary standard

- Ontario Ministry of the Environment, Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act, 2011

#### Tertiary standard

Government of Alberta, Alberta Tier 1 Soil and Groundwater Remediation Guidelines 2010

1.1(3) The following rules are to be applied to determine which standard set out in subsection (2) is to be used:

- Rule 1 If a standard for a contaminant in relation to the applicable site conditions is provided in a primary standard, that is the standard to be used.
- Rule 2 If a contaminant is not listed in a primary standard or if none of the primary standards address the applicable site conditions, the secondary standard is to be used if the secondary standard addresses the specific contaminant and the applicable site conditions.
- Rule 3 If a contaminant is not listed in the primary or secondary standards or if the primary and secondary standards do not address the applicable site conditions, the tertiary standard is to be used if the tertiary standard addresses the specific contaminant and the applicable site conditions.

As such, the Canadian Council of Ministers of the Environment (CCME) industrial land use guidelines have been applied to sample data collected on CN property, in this case, the CN ROW.

Assessment beyond CN-owned lands for the surrounding agricultural lands and within the oxbow has and will continue to emphasize comparison with CCME agricultural land use guidelines and the freshwater aquatic life guidelines, respectively.

### **CURRENT STATUS OF THE SITE**

Monitoring is ongoing at the Site with surface water sampling completed monthly. Groundwater monitoring and sampling were completed monthly between May and September, and the frequency has been increased to every two weeks until freeze-up, to expand the dataset for groundwater analytical results.

At this writing, the two temporary berms defining the OMA are no longer required to support site remediation. Additionally, on October 29, 2019, Fisheries and Oceans Canada – Central and Arctic Region (DFO) provided direction that the temporary berms are to be removed, and included the following condition: *“Assuming appropriate mitigation measures are adhered to (timing, erosion and sediment controls, etc.), the berms should be removed as soon as is feasible to do so”*. As such, plans for Site reclamation have been developed and are pending, based on permission to access private lands.

## **CLOSING**

In response to the Letter of Designation issued by MSD on February 21, 2019 for the Site described as “SW 13-16-28 W, Rural Municipality (RM) of Ellice-Archie, Manitoba”, and as a component outlined in the Remedial Action Plan for the Site, an ESA Report will be completed for the Site following the implementation of the long-term monitoring plan. This report will include a comprehensive summary of the remedial activities completed at the Site including all analytical results and supporting documentation. The ESA Report will clearly outline the conditions of the Site.

## **Appendix A**



Your Project #: 10161797  
Site Location: CN MP 197.4 RIVERS  
Your C.O.C. #: 594348-01-01

**Attention: Jeremy Zemek**

HDR Corporation  
639 5 Avenue SW  
Suite 1510  
Calgary, AB  
CANADA T2P 0M9

**Report Date: 2019/10/22**  
Report #: R2799762  
Version: 1 - Final

**CERTIFICATE OF ANALYSIS**

**BV LABS JOB #: B990420**

**Received: 2019/10/21, 08:00**

Sample Matrix: Water  
# Samples Received: 3

Analyses	Date		Date Analyzed	Laboratory Method	Analytical Method
	Quantity	Extracted			
BTEX/F1 in Water by HS GC/MS/FID (1)	3	N/A	2019/10/22	AB SOP-00039	CCME CWS/EPA 8260d m
F1-BTEX (1)	3	N/A	2019/10/22		Auto Calc
CCME Hydrocarbons (F2-F4 in water) (1, 2)	3	2019/10/22	2019/10/22	AB SOP-00037	CCME PHC-CWS m
Benzo[a]pyrene Equivalency (1, 3)	3	N/A	2019/10/22		Auto Calc
PAH in Water by GC/MS (1)	3	2019/10/22	2019/10/22	AB SOP-00037 / AB SOP-00003	EPA 3510C/8270E m
Total LMW, HMW, Total PAH Calc (1)	3	N/A	2019/10/22		Auto Calc

**Remarks:**

Bureau Veritas Laboratories are accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by BV Labs are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in BV Labs profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and BV Labs in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

BV Labs liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. BV Labs has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by BV Labs, unless otherwise agreed in writing. BV Labs is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.

Results relate to samples tested. When sampling is not conducted by BV Labs, results relate to the supplied samples tested.

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Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.

\* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

(1) This test was performed by BV Labs Calgary Environmental

(2) Silica gel clean up employed.

(3) B[a]P TPE is calculated using 1/2 of the RDL for non detect results as per Alberta Environment instructions. This protocol may not apply in other jurisdictions.



Your Project #: 10161797  
Site Location: CN MP 197.4 RIVERS  
Your C.O.C. #: 594348-01-01

**Attention: Jeremy Zemek**

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**Report Date: 2019/10/22**  
Report #: R2799762  
Version: 1 - Final

**CERTIFICATE OF ANALYSIS**

**BV LABS JOB #: B990420**

**Received: 2019/10/21, 08:00**

Encryption Key



**AUTHORIZED REPORT  
RAPPORT AUTORISÉ**

Bureau Veritas Laboratories

22 Oct 2019 16:38:27

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Customer Solutions, Western Canada Customer Experience Team  
Email: customersolutionswest@bvlabs.com  
Phone# (204) 772-7276

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BUREAU  
VERITAS

BV Labs Job #: B990420  
Report Date: 2019/10/22

HDR Corporation  
Client Project #: 10161797  
Site Location: CN MP 197.4 RIVERS  
Sampler Initials: KH

### AT1 BTEX AND F1-F4 IN WATER (WATER)

BV Labs ID		WT3364	WT3365	WT3366		
Sampling Date		2019/10/18	2019/10/18	2019/10/18		
COC Number		594348-01-01	594348-01-01	594348-01-01		
	UNITS	19-SW1	19-SW2	19-SW3	RDL	QC Batch
<b>Ext. Pet. Hydrocarbon</b>						
F2 (C10-C16 Hydrocarbons)	mg/L	<0.10	<0.10	<0.10	0.10	9636011
F3 (C16-C34 Hydrocarbons)	mg/L	<0.10	<0.10	<0.10	0.10	9636011
F4 (C34-C50 Hydrocarbons)	mg/L	<0.20	<0.20	<0.20	0.20	9636011
<b>Volatiles</b>						
Benzene	ug/L	<0.40	<0.40	<0.40	0.40	9636395
Toluene	ug/L	<0.40	<0.40	<0.40	0.40	9636395
Ethylbenzene	ug/L	<0.40	<0.40	<0.40	0.40	9636395
m & p-Xylene	ug/L	<0.80	<0.80	<0.80	0.80	9636395
o-Xylene	ug/L	<0.40	<0.40	<0.40	0.40	9636395
Xylenes (Total)	ug/L	<0.89	<0.89	<0.89	0.89	9637945
F1 (C6-C10) - BTEX	ug/L	<100	<100	<100	100	9637945
F1 (C6-C10)	ug/L	<100	<100	<100	100	9636395
<b>Surrogate Recovery (%)</b>						
1,4-Difluorobenzene (sur.)	%	101	100	100	N/A	9636395
4-Bromofluorobenzene (sur.)	%	98	98	98	N/A	9636395
D4-1,2-Dichloroethane (sur.)	%	98	98	100	N/A	9636395
O-TERPHENYL (sur.)	%	91	88	91	N/A	9636011
RDL = Reportable Detection Limit						
N/A = Not Applicable						



BUREAU  
VERITAS

BV Labs Job #: B990420

Report Date: 2019/10/22

HDR Corporation

Client Project #: 10161797

Site Location: CN MP 197.4 RIVERS

Sampler Initials: KH

### PAH IN WATER BY GC/MS (WATER)

BV Labs ID		WT3364	WT3365	WT3366		
Sampling Date		2019/10/18	2019/10/18	2019/10/18		
COC Number		594348-01-01	594348-01-01	594348-01-01		
	UNITS	19-SW1	19-SW2	19-SW3	RDL	QC Batch
<b>Polycyclic Aromatics</b>						
Low Molecular Weight PAH's	ug/L	<0.20	<0.20	<0.20	0.20	9637948
High Molecular Weight PAH's	ug/L	<0.050	<0.050	<0.050	0.050	9637948
Total PAH	ug/L	<0.20	<0.20	<0.20	0.20	9637948
B[a]P TPE Total Potency Equivalents	ug/L	<0.010	<0.010	<0.010	0.010	9637947
Acenaphthene	ug/L	<0.10	<0.10	<0.10	0.10	9636546
Acenaphthylene	ug/L	<0.10	<0.10	<0.10	0.10	9636546
Acridine	ug/L	<0.040	<0.040	<0.040	0.040	9636546
Anthracene	ug/L	<0.010	<0.010	<0.010	0.010	9636546
Benzo(a)anthracene	ug/L	<0.0085	<0.0085	<0.0085	0.0085	9636546
Benzo(b&j)fluoranthene	ug/L	<0.0085	<0.0085	<0.0085	0.0085	9636546
Benzo(k)fluoranthene	ug/L	<0.0085	<0.0085	<0.0085	0.0085	9636546
Benzo(g,h,i)perylene	ug/L	<0.0085	<0.0085	<0.0085	0.0085	9636546
Benzo(c)phenanthrene	ug/L	<0.050	<0.050	<0.050	0.050	9636546
Benzo(a)pyrene	ug/L	<0.0075	<0.0075	<0.0075	0.0075	9636546
Benzo(e)pyrene	ug/L	<0.050	<0.050	<0.050	0.050	9636546
Chrysene	ug/L	<0.0085	<0.0085	<0.0085	0.0085	9636546
Dibenz(a,h)anthracene	ug/L	<0.0075	<0.0075	<0.0075	0.0075	9636546
Fluoranthene	ug/L	<0.010	<0.010	<0.010	0.010	9636546
Fluorene	ug/L	<0.050	<0.050	<0.050	0.050	9636546
Indeno(1,2,3-cd)pyrene	ug/L	<0.0085	<0.0085	<0.0085	0.0085	9636546
2-Methylnaphthalene	ug/L	<0.10	<0.10	<0.10	0.10	9636546
Naphthalene	ug/L	<0.10	<0.10	<0.10	0.10	9636546
Phenanthrene	ug/L	<0.050	<0.050	<0.050	0.050	9636546
Perylene	ug/L	<0.050	<0.050	<0.050	0.050	9636546
Pyrene	ug/L	<0.020	<0.020	<0.020	0.020	9636546
Quinoline	ug/L	<0.20	<0.20	<0.20	0.20	9636546
<b>Surrogate Recovery (%)</b>						
D10-ANTHRACENE (sur.)	%	92	89	93	N/A	9636546
D8-ACENAPHTHYLENE (sur.)	%	86	86	88	N/A	9636546
D8-NAPHTHALENE (sur.)	%	73	71	75	N/A	9636546
TERPHENYL-D14 (sur.)	%	83	80	84	N/A	9636546
RDL = Reportable Detection Limit						
N/A = Not Applicable						



BUREAU  
VERITAS

BV Labs Job #: B990420

Report Date: 2019/10/22

HDR Corporation

Client Project #: 10161797

Site Location: CN MP 197.4 RIVERS

Sampler Initials: KH

### GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	7.0°C
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Results relate only to the items tested.



BV Labs Job #: B990420  
Report Date: 2019/10/22

## QUALITY ASSURANCE REPORT

HDR Corporation  
Client Project #: 10161797  
Site Location: CN MP 197.4 RIVERS  
Sampler Initials: KH

QC Batch	Parameter	Date	Matrix Spike		Spiked Blank		Method Blank		RPD	
			% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
9636011	O-TERPHENYL (sur.)	2019/10/22	96	60 - 140	90	60 - 140	99	%		
9636395	1,4-Difluorobenzene (sur.)	2019/10/22	100	50 - 140	102	50 - 140	99	%		
9636395	4-Bromofluorobenzene (sur.)	2019/10/22	100	50 - 140	104	50 - 140	99	%		
9636395	D4-1,2-Dichloroethane (sur.)	2019/10/22	88	50 - 140	89	50 - 140	85	%		
9636546	D10-ANTHRACENE (sur.)	2019/10/21	117	50 - 130	121	50 - 130	121	%		
9636546	D8-ACENAPHTHYLENE (sur.)	2019/10/21	104	50 - 130	106	50 - 130	105	%		
9636546	D8-NAPHTHALENE (sur.)	2019/10/21	81	50 - 130	84	50 - 130	80	%		
9636546	TERPHENYL-D14 (sur.)	2019/10/21	123	50 - 130	130	50 - 130	128	%		
9636011	F2 (C10-C16 Hydrocarbons)	2019/10/22	97	60 - 140	91	60 - 140	<0.10	mg/L	NC	30
9636011	F3 (C16-C34 Hydrocarbons)	2019/10/22	101	60 - 140	91	60 - 140	<0.10	mg/L	NC	30
9636011	F4 (C34-C50 Hydrocarbons)	2019/10/22	93	60 - 140	87	60 - 140	<0.20	mg/L	NC	30
9636395	Benzene	2019/10/22	72	50 - 140	85	60 - 130	<0.40	ug/L	NC	30
9636395	Ethylbenzene	2019/10/22	73	50 - 140	86	60 - 130	<0.40	ug/L	NC	30
9636395	F1 (C6-C10)	2019/10/22	82	60 - 140	78	60 - 140	<100	ug/L	NC	30
9636395	m & p-Xylene	2019/10/22	72	50 - 140	85	60 - 130	<0.80	ug/L	NC	30
9636395	o-Xylene	2019/10/22	75	50 - 140	87	60 - 130	<0.40	ug/L	NC	30
9636395	Toluene	2019/10/22	72	50 - 140	85	60 - 130	<0.40	ug/L	NC	30
9636546	2-Methylnaphthalene	2019/10/21	78	50 - 130	77	50 - 130	<0.10	ug/L	NC	30
9636546	Acenaphthene	2019/10/21	90	50 - 130	85	50 - 130	<0.10	ug/L	NC	30
9636546	Acenaphthylene	2019/10/21	93	50 - 130	90	50 - 130	<0.10	ug/L	NC	30
9636546	Acridine	2019/10/21	86	50 - 130	86	50 - 130	<0.040	ug/L	NC	30
9636546	Anthracene	2019/10/21	89	50 - 130	88	50 - 130	<0.010	ug/L	NC	30
9636546	Benzo(a)anthracene	2019/10/21	98	50 - 130	103	50 - 130	<0.0085	ug/L	NC	30
9636546	Benzo(a)pyrene	2019/10/21	103	50 - 130	110	50 - 130	<0.0075	ug/L	NC	30
9636546	Benzo(b&j)fluoranthene	2019/10/21	90	50 - 130	95	50 - 130	<0.0085	ug/L	NC	30
9636546	Benzo(c)phenanthrene	2019/10/21	99	50 - 130	101	50 - 130	<0.050	ug/L	NC	30
9636546	Benzo(e)pyrene	2019/10/21	92	50 - 130	98	50 - 130	<0.050	ug/L	NC	30
9636546	Benzo(g,h,i)perylene	2019/10/21	93	50 - 130	98	50 - 130	<0.0085	ug/L	NC	30
9636546	Benzo(k)fluoranthene	2019/10/21	90	50 - 130	96	50 - 130	<0.0085	ug/L	NC	30
9636546	Chrysene	2019/10/21	93	50 - 130	97	50 - 130	<0.0085	ug/L	NC	30
9636546	Dibenz(a,h)anthracene	2019/10/21	99	50 - 130	109	50 - 130	<0.0075	ug/L	NC	30
9636546	Fluoranthene	2019/10/21	95	50 - 130	95	50 - 130	<0.010	ug/L	NC	30



BV Labs Job #: B990420  
Report Date: 2019/10/22

## QUALITY ASSURANCE REPORT(CONT'D)

HDR Corporation  
Client Project #: 10161797  
Site Location: CN MP 197.4 RIVERS  
Sampler Initials: KH

QC Batch	Parameter	Date	Matrix Spike		Spiked Blank		Method Blank		RPD	
			% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
9636546	Fluorene	2019/10/21	96	50 - 130	89	50 - 130	<0.050	ug/L	NC	30
9636546	Indeno(1,2,3-cd)pyrene	2019/10/21	100	50 - 130	110	50 - 130	<0.0085	ug/L	NC	30
9636546	Naphthalene	2019/10/21	75	50 - 130	76	50 - 130	<0.10	ug/L	NC	30
9636546	Perylene	2019/10/21	85	50 - 130	90	50 - 130	<0.050	ug/L	NC	30
9636546	Phenanthrene	2019/10/21	89	50 - 130	87	50 - 130	<0.050	ug/L	NC	30
9636546	Pyrene	2019/10/21	94	50 - 130	94	50 - 130	<0.020	ug/L	NC	30
9636546	Quinoline	2019/10/21	99	50 - 130	95	50 - 130	<0.20	ug/L	NC	30

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

Surrogate: A pure or isotopically labeled compound whose behavior mirrors the analytes of interest. Used to evaluate extraction efficiency.

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference  $\leq 2 \times$  RDL).



BUREAU  
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BV Labs Job #: B990420  
Report Date: 2019/10/22

HDR Corporation  
Client Project #: 10161797  
Site Location: CN MP 197.4 RIVERS  
Sampler Initials: KH

### VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

---

Dennis Ngandu, B.Sc., P.Chem., QP, Supervisor, Organics

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Janet Gao, B.Sc., QP, Supervisor, Organics

---

Veronica Falk, B.Sc., P.Chem., QP, Scientific Specialist, Organics

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BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

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Page 1 of 1

Bureau Veritas Laboratories  
4000 19th N.E. Calgary, Alberta Canada T2E 6P8 Tel: (403) 291-3077 Toll-free: 800-563-6266 Fax: (403) 291-9468 www.bvlabs.com

**Chain Of Custody Record**

INVOICE TO:		Report Information		Project Information		Laboratory Use Only																																																																																																																																																											
Company Name #12988 HDR Corporation	Contact Name Jeremy Zemek	Company Name Loni Waldner, Jeremy Zemek	Contact Name Jeremy Zemek	Quotation # B7127	P.O. # 10161797	BV Labs Job #	Bottle Order #																																																																																																																																																										
Address 639 5 Avenue SW Suite 1510 Calgary AB T2P 0M9		Address Jeremy Zemek		Project # CN MP 197.4 Rivers	Project Name	Chain Of Custody Record	Project Manager																																																																																																																																																										
Phone (403) 727-0050	Fax	Phone Jeremy Zemek	Email loni.waldner@hdrinc.com	Site # KH	Sampled By	Customer Solutions																																																																																																																																																											
Regulatory Criteria CCME		Special Instructions		Analysis Requested		Turnaround Time (TAT) Required																																																																																																																																																											
						Please provide advance notice for rush projects																																																																																																																																																											
						Regular (Standard) TAT (will be applied if Rush TAT is not specified) Standard TAT = 5-7 Working days for most tests. Please note: Standard TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details. Job Specific Rush TAT (if applies to entire submission) Date Required: _____ Time Required: _____ Rush Confirmation Number _____ (call lab for #)																																																																																																																																																											
<p>Note: For regulated drinking water samples - please use the Drinking Water Chain of Custody Form</p> <p>Samples must be kept cool (&lt; 10°C) from time of sampling until delivery to BV Labs</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Sample Barcode Label</th> <th>Sample (Location) Identification</th> <th>Date Sampled</th> <th>Time Sampled</th> <th>Matrix</th> <th>Regulated Drinking Water? (Y/N)</th> <th>Metals Field Filtered? (Y/N)</th> <th>AT1 BTEX and F1-F4 in Water</th> <th>PAH in Water by GC/MS</th> <th>Routine Water</th> <th>Regulated Metals (Cd/Cr/As/Pb)</th> <th>Mercury (Dissolved) by CV</th> <th># of Bottles</th> <th>Comments</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>19-SW1</td> <td>10/18/2019</td> <td></td> <td>SW</td> <td></td> <td></td> <td>X</td> <td>X</td> <td></td> <td></td> <td></td> <td>6</td> <td>RUSH TAT **</td> </tr> <tr> <td>2</td> <td>19-SW2</td> <td>↓</td> <td></td> <td>↓</td> <td></td> <td></td> <td>X</td> <td>X</td> <td></td> <td></td> <td></td> <td>6</td> <td>RUSH TAT **</td> </tr> <tr> <td>3</td> <td>19-SW3</td> <td>↓</td> <td></td> <td>↓</td> <td></td> <td></td> <td>X</td> <td>X</td> <td></td> <td></td> <td></td> <td>6</td> <td>RUSH TAT **</td> </tr> <tr><td>4</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>5</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>6</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>7</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>8</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>9</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>10</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> </tbody> </table>								Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Regulated Drinking Water? (Y/N)	Metals Field Filtered? (Y/N)	AT1 BTEX and F1-F4 in Water	PAH in Water by GC/MS	Routine Water	Regulated Metals (Cd/Cr/As/Pb)	Mercury (Dissolved) by CV	# of Bottles	Comments	1	19-SW1	10/18/2019		SW			X	X				6	RUSH TAT **	2	19-SW2	↓		↓			X	X				6	RUSH TAT **	3	19-SW3	↓		↓			X	X				6	RUSH TAT **	4														5														6														7														8														9														10													
Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Regulated Drinking Water? (Y/N)	Metals Field Filtered? (Y/N)	AT1 BTEX and F1-F4 in Water	PAH in Water by GC/MS	Routine Water	Regulated Metals (Cd/Cr/As/Pb)	Mercury (Dissolved) by CV	# of Bottles	Comments																																																																																																																																																				
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RELINQUISHED BY: (Signature/Print) Kelsey Howen		Date: (YY/MM/DD) 19/10/18	Time 19:00	RECEIVED BY: (Signature/Print) Kelsey Howen		Date: (YY/MM/DD) 20/10/22	Time 08:00	# Jars used and not submitted	Lab Use Only																																																																																																																																																								
									Time Sensitive	Temperature (°C) on Receipt	Custody Seal Intact on Cooler?																																																																																																																																																						
									<input type="checkbox"/>	40.35 48	<input type="checkbox"/> Yes <input type="checkbox"/> No																																																																																																																																																						

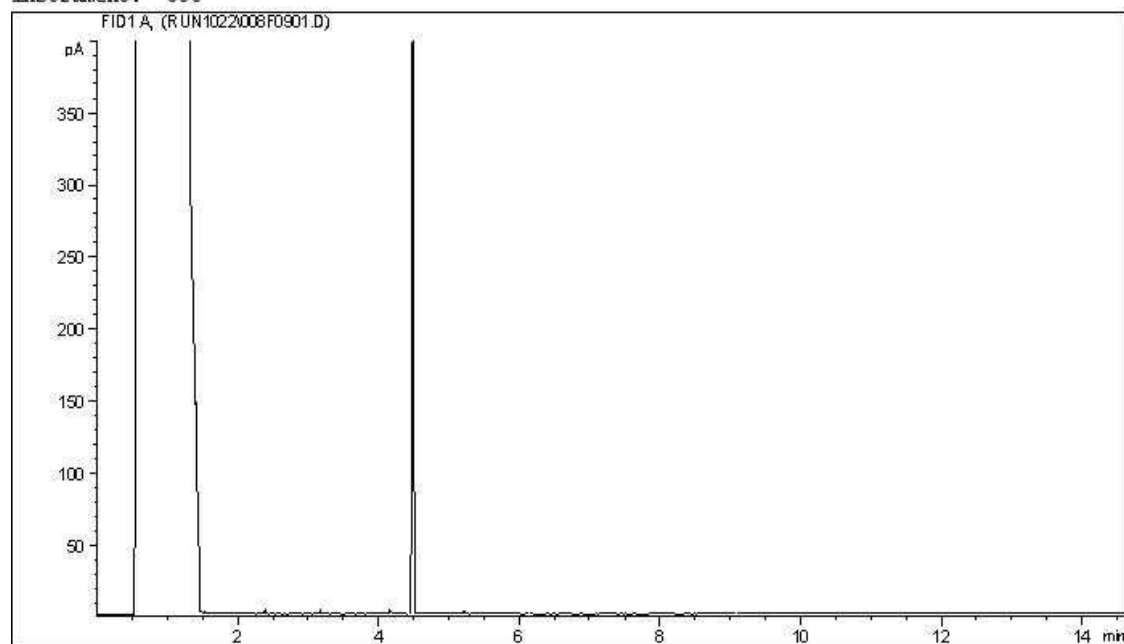
\* UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO BV LABS' STANDARD TERMS AND CONDITIONS. SIGNING OF THIS CHAIN OF CUSTODY DOCUMENT IS ACKNOWLEDGMENT AND ACCEPTANCE OF OUR TERMS WHICH ARE AVAILABLE FOR VIEWING AT WWW.BVLABS.COM/TERMS-AND-CONDITIONS.

\* IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.

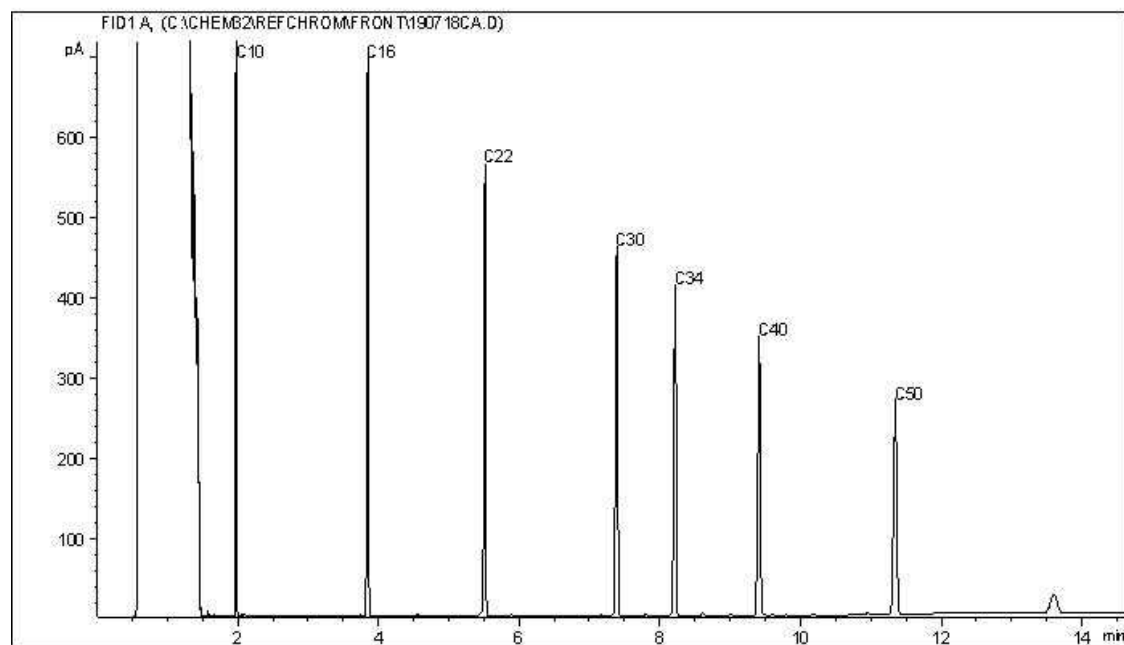
NOTE 81617 KEY  
CSY ice present

# CCME Hydrocarbons (F2-F4 in water) Chromatogram

Instrument: GC6



Carbon Range Distribution - Reference Chromatogram



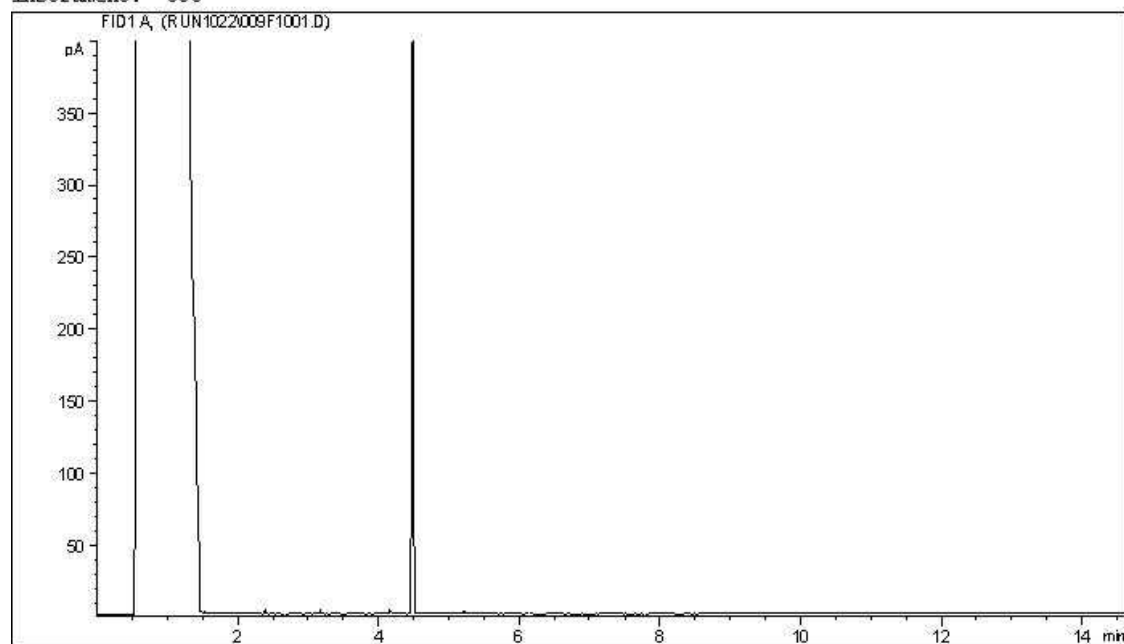
## TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline:	C4 - C12	Diesel:	C8 - C22
Varsol:	C8 - C12	Lubricating Oils:	C20 - C40
Kerosene:	C7 - C16	Crude Oils:	C3 - C60+

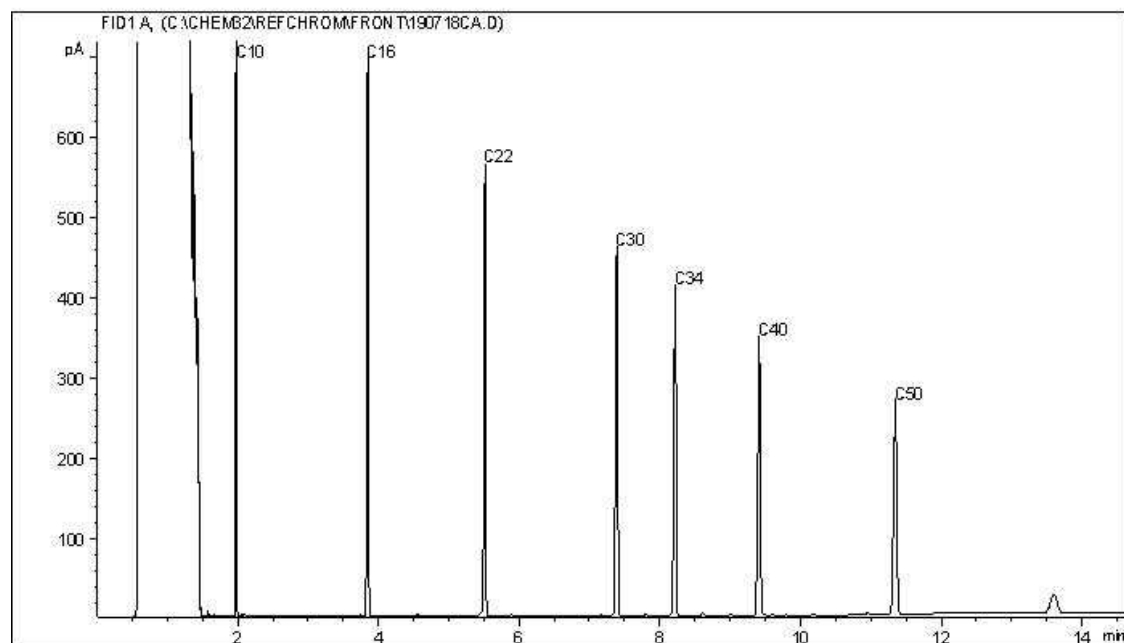
**Note:** This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

# CCME Hydrocarbons (F2-F4 in water) Chromatogram

Instrument: GC6



Carbon Range Distribution - Reference Chromatogram



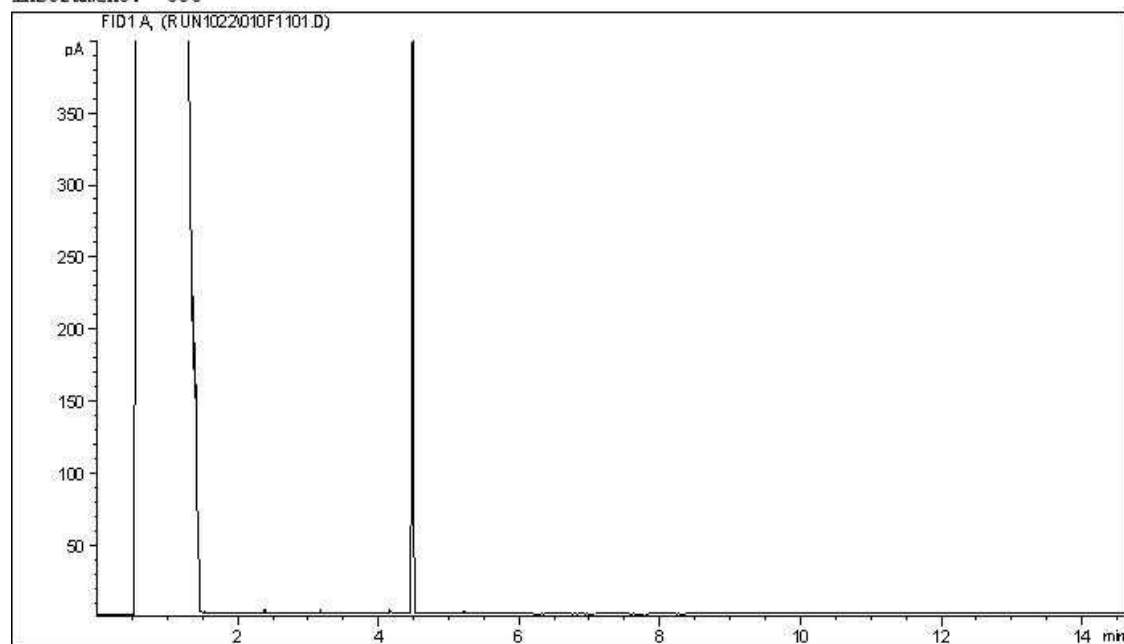
## TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline:	C4 - C12	Diesel:	C8 - C22
Varsol:	C8 - C12	Lubricating Oils:	C20 - C40
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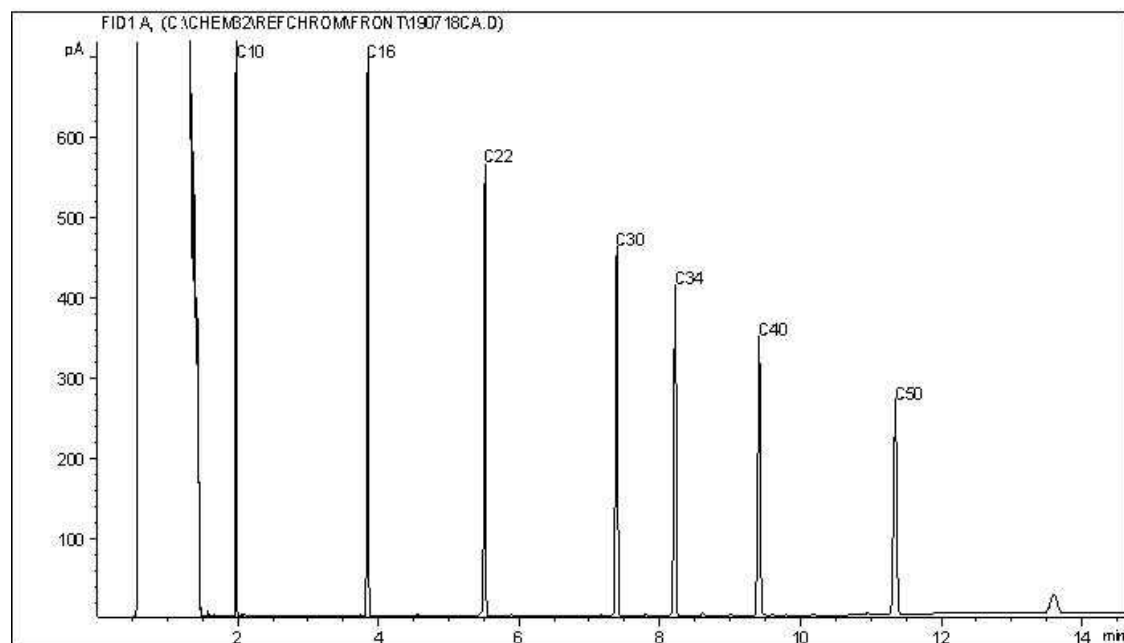
**Note:** This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

# CCME Hydrocarbons (F2-F4 in water) Chromatogram

Instrument: GC6



Carbon Range Distribution - Reference Chromatogram



## TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline:	C4 - C12	Diesel:	C8 - C22
Varsol:	C8 - C12	Lubricating Oils:	C20 - C40
Kerosene:	C7 - C16	Crude Oils:	C3 - C60+

**Note:** This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.



Your Project #: 10161797  
Site Location: CNMP197.4 RIVERS  
Your C.O.C. #: M090538

**Attention: Jeremy Zemek**

HDR Corporation  
639 5 Avenue SW  
Suite 1510  
Calgary, AB  
CANADA T2P 0M9

**Report Date: 2019/10/23**  
Report #: R2800404  
Version: 1 - Final

**CERTIFICATE OF ANALYSIS**

**BV LABS JOB #: B990838**

**Received: 2019/10/22, 08:00**

Sample Matrix: Water  
# Samples Received: 2

Analyses	Date		Date Analyzed	Laboratory Method	Analytical Method
	Quantity	Extracted			
BTEX/F1 in Water by HS GC/MS/FID (1)	2	N/A	2019/10/23	AB SOP-00039	CCME CWS/EPA 8260d m
F1-BTEX (1)	2	N/A	2019/10/23		Auto Calc
CCME Hydrocarbons (F2-F4 in water) (1, 2)	2	2019/10/23	2019/10/23	AB SOP-00037	CCME PHC-CWS m
Benzo[a]pyrene Equivalency (1, 3)	2	N/A	2019/10/23		Auto Calc
PAH in Water by GC/MS (1)	2	2019/10/23	2019/10/23	AB SOP-00037 / AB SOP-00003	EPA 3510C/8270E m

**Remarks:**

Bureau Veritas Laboratories are accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by BV Labs are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in BV Labs profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and BV Labs in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

BV Labs liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. BV Labs has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by BV Labs, unless otherwise agreed in writing. BV Labs is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.

Results relate to samples tested. When sampling is not conducted by BV Labs, results relate to the supplied samples tested.

This Certificate shall not be reproduced except in full, without the written approval of the laboratory.

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.

\* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

(1) This test was performed by BV Labs Calgary Environmental

(2) Silica gel clean up employed.

(3) B[a]P TPE is calculated using 1/2 of the RDL for non detect results as per Alberta Environment instructions. This protocol may not apply in other jurisdictions.



Your Project #: 10161797  
Site Location: CNMP197.4 RIVERS  
Your C.O.C. #: M090538

**Attention: Jeremy Zemek**

HDR Corporation  
639 5 Avenue SW  
Suite 1510  
Calgary, AB  
CANADA T2P 0M9

**Report Date: 2019/10/23**  
Report #: R2800404  
Version: 1 - Final

**CERTIFICATE OF ANALYSIS**

**BV LABS JOB #: B990838**

**Received: 2019/10/22, 08:00**

Encryption Key



**AUTHORIZED REPORT  
RAPPORT AUTORISÉ**

Bureau Veritas Laboratories

23 Oct 2019 17:02:29

Please direct all questions regarding this Certificate of Analysis to your Project Manager.  
Customer Solutions, Western Canada Customer Experience Team  
Email: customersolutionswest@bvlab.com  
Phone# (204) 772-7276

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BV Labs Job #: B990838

Report Date: 2019/10/23

HDR Corporation

Client Project #: 10161797

Site Location: CNMP197.4 RIVERS

Sampler Initials: JZ

### AT1 BTEX AND F1-F4 IN WATER (WATER)

BV Labs ID		WT6178	WT6179	WT6179		
Sampling Date		2019/10/21 13:00	2019/10/21 13:00	2019/10/21 13:00		
COC Number		M090538	M090538	M090538		
	UNITS	INSIDE	OUTSIDE	OUTSIDE Lab-Dup	RDL	QC Batch
<b>Ext. Pet. Hydrocarbon</b>						
F2 (C10-C16 Hydrocarbons)	mg/L	<0.10	<0.10	<0.10	0.10	9636006
F3 (C16-C34 Hydrocarbons)	mg/L	<0.10	<0.10	<0.10	0.10	9636006
F4 (C34-C50 Hydrocarbons)	mg/L	<0.20	<0.20	<0.20	0.20	9636006
<b>Volatiles</b>						
Benzene	ug/L	<0.40	<0.40	N/A	0.40	9637918
Toluene	ug/L	<0.40	<0.40	N/A	0.40	9637918
Ethylbenzene	ug/L	<0.40	<0.40	N/A	0.40	9637918
m & p-Xylene	ug/L	<0.80	<0.80	N/A	0.80	9637918
o-Xylene	ug/L	<0.40	<0.40	N/A	0.40	9637918
Xylenes (Total)	ug/L	<0.89	<0.89	N/A	0.89	9639227
F1 (C6-C10) - BTEX	ug/L	<100	<100	N/A	100	9639227
F1 (C6-C10)	ug/L	<100	<100	N/A	100	9637918
<b>Surrogate Recovery (%)</b>						
1,4-Difluorobenzene (sur.)	%	100	101	N/A	N/A	9637918
4-Bromofluorobenzene (sur.)	%	98	97	N/A	N/A	9637918
D4-1,2-Dichloroethane (sur.)	%	99	98	N/A	N/A	9637918
O-TERPHENYL (sur.)	%	96	96	96	N/A	9636006
RDL = Reportable Detection Limit						
Lab-Dup = Laboratory Initiated Duplicate						
N/A = Not Applicable						



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### SEMIVOLATILE ORGANICS BY GC-MS (WATER)

BV Labs ID		WT6178	WT6179	WT6179		
Sampling Date		2019/10/21 13:00	2019/10/21 13:00	2019/10/21 13:00		
COC Number		M090538	M090538	M090538		
	UNITS	INSIDE	OUTSIDE	OUTSIDE Lab-Dup	RDL	QC Batch
<b>Polycyclic Aromatics</b>						
B[a]P TPE Total Potency Equivalents	ug/L	<0.010	<0.010	N/A	0.010	9639430
Acenaphthene	ug/L	<0.10	<0.10	<0.10	0.10	9636009
Acenaphthylene	ug/L	<0.10	<0.10	<0.10	0.10	9636009
Acridine	ug/L	<0.040	<0.040	<0.040	0.040	9636009
Anthracene	ug/L	<0.010	<0.010	<0.010	0.010	9636009
Benzo(a)anthracene	ug/L	<0.0085	<0.0085	<0.0085	0.0085	9636009
Benzo(b&j)fluoranthene	ug/L	<0.0085	<0.0085	<0.0085	0.0085	9636009
Benzo(k)fluoranthene	ug/L	<0.0085	<0.0085	<0.0085	0.0085	9636009
Benzo(g,h,i)perylene	ug/L	<0.0085	<0.0085	<0.0085	0.0085	9636009
Benzo(c)phenanthrene	ug/L	<0.050	<0.050	<0.050	0.050	9636009
Benzo(a)pyrene	ug/L	<0.0075	<0.0075	<0.0075	0.0075	9636009
Benzo(e)pyrene	ug/L	<0.050	<0.050	<0.050	0.050	9636009
Chrysene	ug/L	<0.0085	<0.0085	<0.0085	0.0085	9636009
Dibenz(a,h)anthracene	ug/L	<0.0075	<0.0075	<0.0075	0.0075	9636009
Fluoranthene	ug/L	<0.010	<0.010	<0.010	0.010	9636009
Fluorene	ug/L	<0.050	<0.050	<0.050	0.050	9636009
Indeno(1,2,3-cd)pyrene	ug/L	<0.0085	<0.0085	<0.0085	0.0085	9636009
1-Methylnaphthalene	ug/L	<0.10	<0.10	<0.10	0.10	9636009
2-Methylnaphthalene	ug/L	<0.10	<0.10	<0.10	0.10	9636009
Naphthalene	ug/L	<0.10	<0.10	<0.10	0.10	9636009
Phenanthrene	ug/L	<0.050	<0.050	<0.050	0.050	9636009
Perylene	ug/L	<0.050	<0.050	<0.050	0.050	9636009
Pyrene	ug/L	<0.020	<0.020	<0.020	0.020	9636009
Quinoline	ug/L	<0.20	<0.20	<0.20	0.20	9636009
<b>Surrogate Recovery (%)</b>						
D10-ANTHRACENE (sur.)	%	95	98	112	N/A	9636009
D8-ACENAPHTHYLENE (sur.)	%	85	85	100	N/A	9636009
D8-NAPHTHALENE (sur.)	%	69	74	87	N/A	9636009
TERPHENYL-D14 (sur.)	%	87	89	101	N/A	9636009
RDL = Reportable Detection Limit						
Lab-Dup = Laboratory Initiated Duplicate						
N/A = Not Applicable						



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### GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	7.1°C
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Results relate only to the items tested.



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## QUALITY ASSURANCE REPORT

HDR Corporation  
Client Project #: 10161797  
Site Location: CNMP197.4 RIVERS  
Sampler Initials: JZ

QC Batch	Parameter	Date	Matrix Spike		Spiked Blank		Method Blank		RPD	
			% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
9636006	O-TERPHENYL (sur.)	2019/10/23	99	60 - 140	97	60 - 140	95	%		
9636009	D10-ANTHRACENE (sur.)	2019/10/23	90	50 - 130	99	50 - 130	107	%		
9636009	D8-ACENAPHTHYLENE (sur.)	2019/10/23	80	50 - 130	86	50 - 130	93	%		
9636009	D8-NAPHTHALENE (sur.)	2019/10/23	65	50 - 130	69	50 - 130	77	%		
9636009	TERPHENYL-D14 (sur.)	2019/10/23	83	50 - 130	90	50 - 130	95	%		
9637918	1,4-Difluorobenzene (sur.)	2019/10/22	102	50 - 140	104	50 - 140	105	%		
9637918	4-Bromofluorobenzene (sur.)	2019/10/22	100	50 - 140	99	50 - 140	101	%		
9637918	D4-1,2-Dichloroethane (sur.)	2019/10/22	101	50 - 140	101	50 - 140	94	%		
9636006	F2 (C10-C16 Hydrocarbons)	2019/10/23	106	60 - 140	102	60 - 140	<0.10	mg/L	NC	30
9636006	F3 (C16-C34 Hydrocarbons)	2019/10/23	115	60 - 140	113	60 - 140	<0.10	mg/L	NC	30
9636006	F4 (C34-C50 Hydrocarbons)	2019/10/23	108	60 - 140	105	60 - 140	<0.20	mg/L	NC	30
9636009	1-Methylnaphthalene	2019/10/23	71	50 - 130	80	50 - 130	<0.10	ug/L	NC	30
9636009	2-Methylnaphthalene	2019/10/23	68	50 - 130	76	50 - 130	<0.10	ug/L	NC	30
9636009	Acenaphthene	2019/10/23	77	50 - 130	87	50 - 130	<0.10	ug/L	NC	30
9636009	Acenaphthylene	2019/10/23	77	50 - 130	87	50 - 130	<0.10	ug/L	NC	30
9636009	Acridine	2019/10/23	79	50 - 130	87	50 - 130	<0.040	ug/L	NC	30
9636009	Anthracene	2019/10/23	84	50 - 130	92	50 - 130	<0.010	ug/L	NC	30
9636009	Benzo(a)anthracene	2019/10/23	89	50 - 130	107	50 - 130	<0.0085	ug/L	NC	30
9636009	Benzo(a)pyrene	2019/10/23	94	50 - 130	113	50 - 130	<0.0075	ug/L	NC	30
9636009	Benzo(b&j)fluoranthene	2019/10/23	82	50 - 130	99	50 - 130	<0.0085	ug/L	NC	30
9636009	Benzo(c)phenanthrene	2019/10/23	95	50 - 130	108	50 - 130	<0.050	ug/L	NC	30
9636009	Benzo(e)pyrene	2019/10/23	86	50 - 130	103	50 - 130	<0.050	ug/L	NC	30
9636009	Benzo(g,h,i)perylene	2019/10/23	86	50 - 130	101	50 - 130	<0.0085	ug/L	NC	30
9636009	Benzo(k)fluoranthene	2019/10/23	91	50 - 130	107	50 - 130	<0.0085	ug/L	NC	30
9636009	Chrysene	2019/10/23	90	50 - 130	105	50 - 130	<0.0085	ug/L	NC	30
9636009	Dibenz(a,h)anthracene	2019/10/23	87	50 - 130	108	50 - 130	<0.0075	ug/L	NC	30
9636009	Fluoranthene	2019/10/23	89	50 - 130	100	50 - 130	<0.010	ug/L	NC	30
9636009	Fluorene	2019/10/23	80	50 - 130	88	50 - 130	<0.050	ug/L	NC	30
9636009	Indeno(1,2,3-cd)pyrene	2019/10/23	87	50 - 130	104	50 - 130	<0.0085	ug/L	NC	30
9636009	Naphthalene	2019/10/23	67	50 - 130	75	50 - 130	<0.10	ug/L	NC	30
9636009	Perylene	2019/10/23	82	50 - 130	97	50 - 130	<0.050	ug/L	NC	30
9636009	Phenanthrene	2019/10/23	86	50 - 130	94	50 - 130	<0.050	ug/L	NC	30



BV Labs Job #: B990838  
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## QUALITY ASSURANCE REPORT(CONT'D)

HDR Corporation  
Client Project #: 10161797  
Site Location: CNMP197.4 RIVERS  
Sampler Initials: JZ

QC Batch	Parameter	Date	Matrix Spike		Spiked Blank		Method Blank		RPD	
			% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
9636009	Pyrene	2019/10/23	88	50 - 130	99	50 - 130	<0.020	ug/L	NC	30
9636009	Quinoline	2019/10/23	114	50 - 130	112	50 - 130	<0.20	ug/L	NC	30
9637918	Benzene	2019/10/22	91	50 - 140	98	60 - 130	<0.40	ug/L	0.58	30
9637918	Ethylbenzene	2019/10/22	84	50 - 140	91	60 - 130	<0.40	ug/L	NC	30
9637918	F1 (C6-C10)	2019/10/22	77	60 - 140	97	60 - 140	<100	ug/L	NC	30
9637918	m & p-Xylene	2019/10/22	84	50 - 140	91	60 - 130	<0.80	ug/L	4.0	30
9637918	o-Xylene	2019/10/22	88	50 - 140	94	60 - 130	<0.40	ug/L	NC	30
9637918	Toluene	2019/10/22	82	50 - 140	88	60 - 130	<0.40	ug/L	0	30

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

Surrogate: A pure or isotopically labeled compound whose behavior mirrors the analytes of interest. Used to evaluate extraction efficiency.

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference  $\leq 2 \times \text{RDL}$ ).



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BV Labs Job #: B990838  
Report Date: 2019/10/23

HDR Corporation  
Client Project #: 10161797  
Site Location: CNMP197.4 RIVERS  
Sampler Initials: JZ

### VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

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Dennis Ngandu, B.Sc., P.Chem., QP, Supervisor, Organics

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Janet Gao, B.Sc., QP, Supervisor, Organics

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Veronica Falk, B.Sc., P.Chem., QP, Scientific Specialist, Organics

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## CHAIN OF CUSTODY RECORD

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M 090538

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Invoice Information				Report Information (if differs from invoice)				Project Information				Turnaround Time (TAT) Required			
Company: <b>HDR</b>				Company: _____				Quotation #: <b>B7217</b>				<input type="checkbox"/> 5 - 7 Days Regular (Most analyses)			
Contact Name: <b>Jeremy Zemek</b>				Contact Name: _____				P.O. #/ AFE#: _____				PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS			
Address: <b>639 S Ave SW, Suite 1510 Calgary, AB T2P 0M9</b>				Address: _____				Project #: <b>CNMP197.4 Rivers</b>				Rush TAT (Surcharges will be applied) <input type="checkbox"/> Same Day <input type="checkbox"/> 2 Days <input checked="" type="checkbox"/> 1 Day <input type="checkbox"/> 3-4 Days			
Phone: _____				Phone: _____				Site Location: <b>7016797</b>				Date Required: _____			
Email: <b>Jeremy.Zemek@hdrinc.com</b>				Email: _____				Site #: _____				Rush Confirmation #: _____			
Copies: <b>Loni.Waldpeter@hdrinc.com</b>				Copies: _____				Sampled By: <b>SZ+MA</b>							

Laboratory Use Only										Analysis Requested										Regulatory Criteria																																																																																																																																																																																																																																																																																																																																		
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Please indicate Filtered, Preserved or Both (F, P, F/P)

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<b>J. Zemek</b>	<b>2019/10/21</b>	<b>1530</b>	<b>Brooklyn, H</b>	<b>2019/10/22</b>	<b>0800</b>
			<b>Tina W. White</b>	<b>2019/10/23</b>	<b>08:00</b>

22-Oct-19 08:00

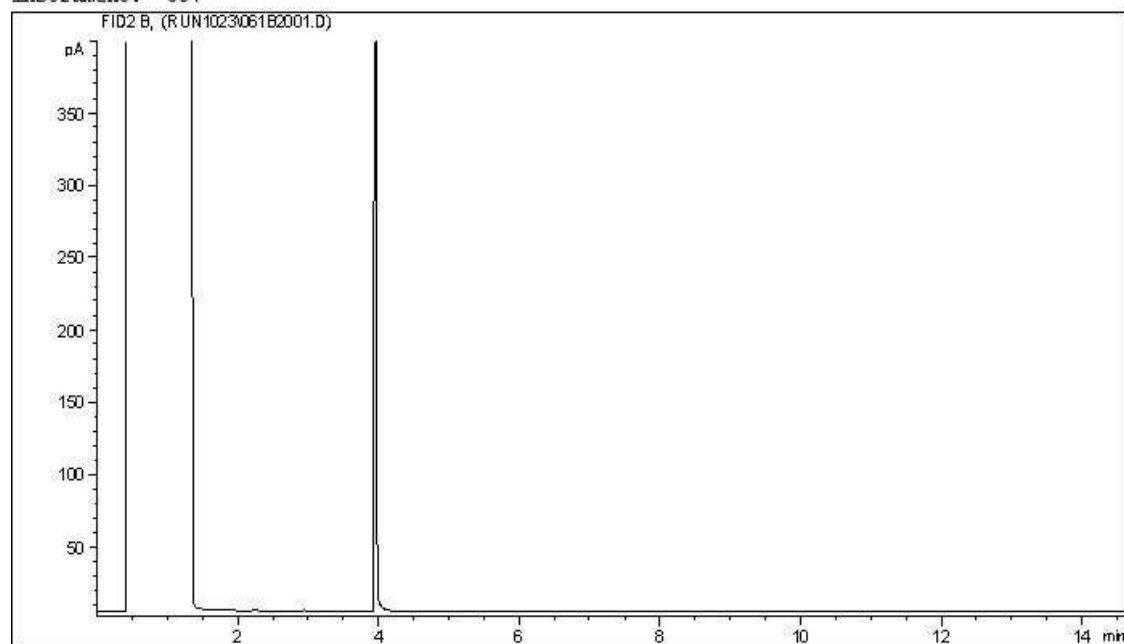
Customer Solutions

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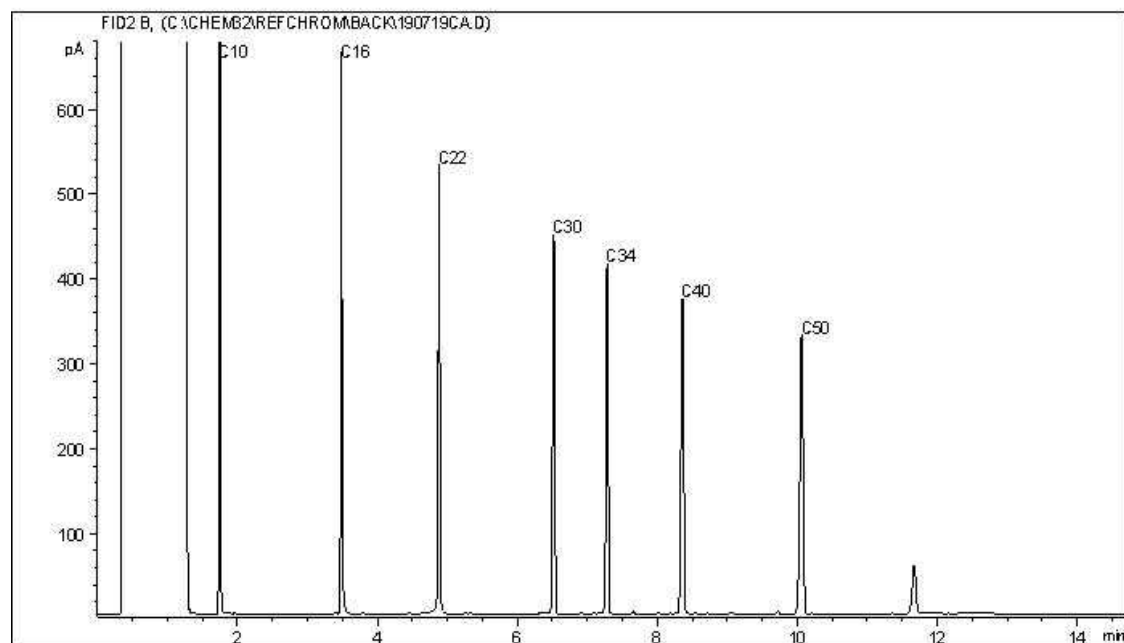
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# CCME Hydrocarbons (F2-F4 in water) Chromatogram

Instrument: GC7



Carbon Range Distribution - Reference Chromatogram



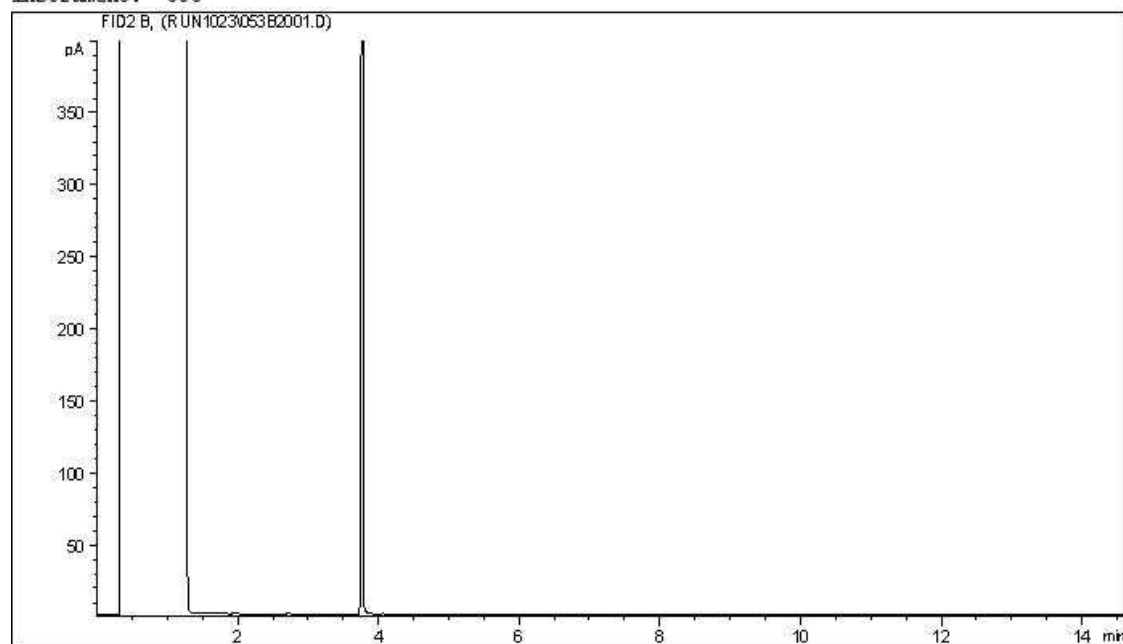
## TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline:	C4 - C12	Diesel:	C8 - C22
Varsol:	C8 - C12	Lubricating Oils:	C20 - C40
Kerosene:	C7 - C16	Crude Oils:	C3 - C60+

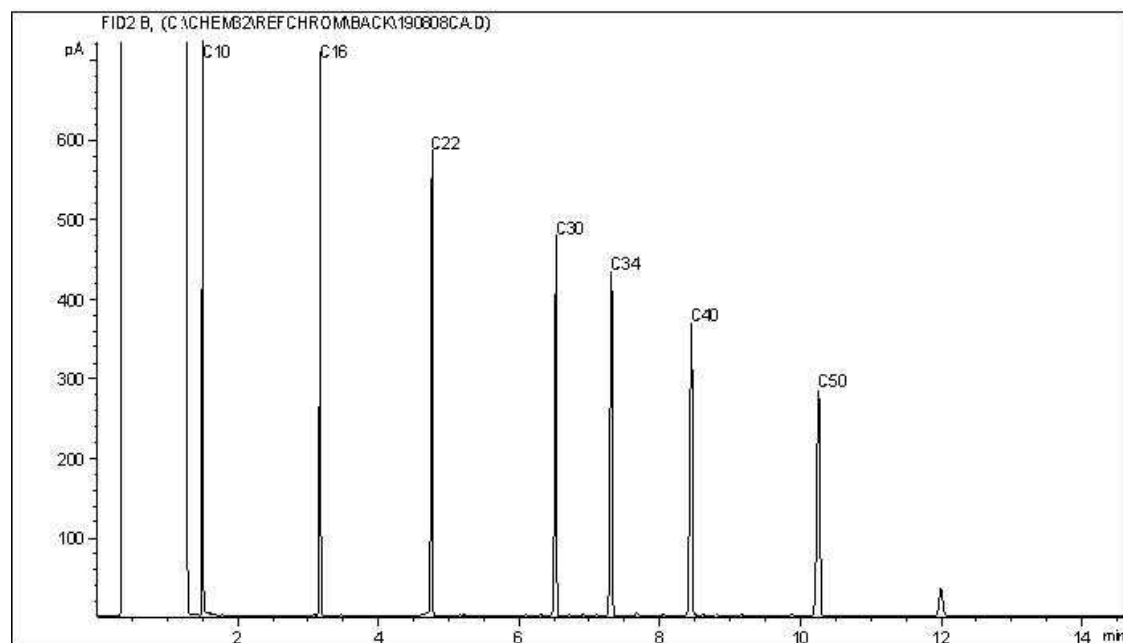
**Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.**

### CCME Hydrocarbons (F2-F4 in water) Chromatogram

Instrument: GC6



Carbon Range Distribution - Reference Chromatogram



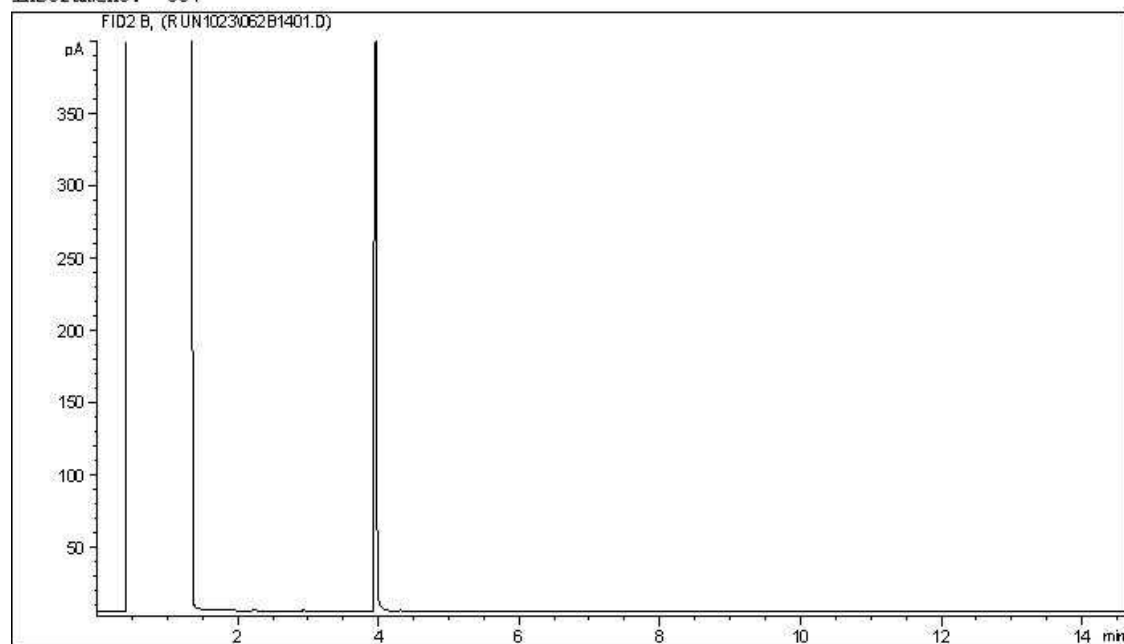
#### TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline:	C4 - C12	Diesel:	C8 - C22
Varsol:	C8 - C12	Lubricating Oils:	C20 - C40
Kerosene:	C7 - C16	Crude Oils:	C3 - C60+

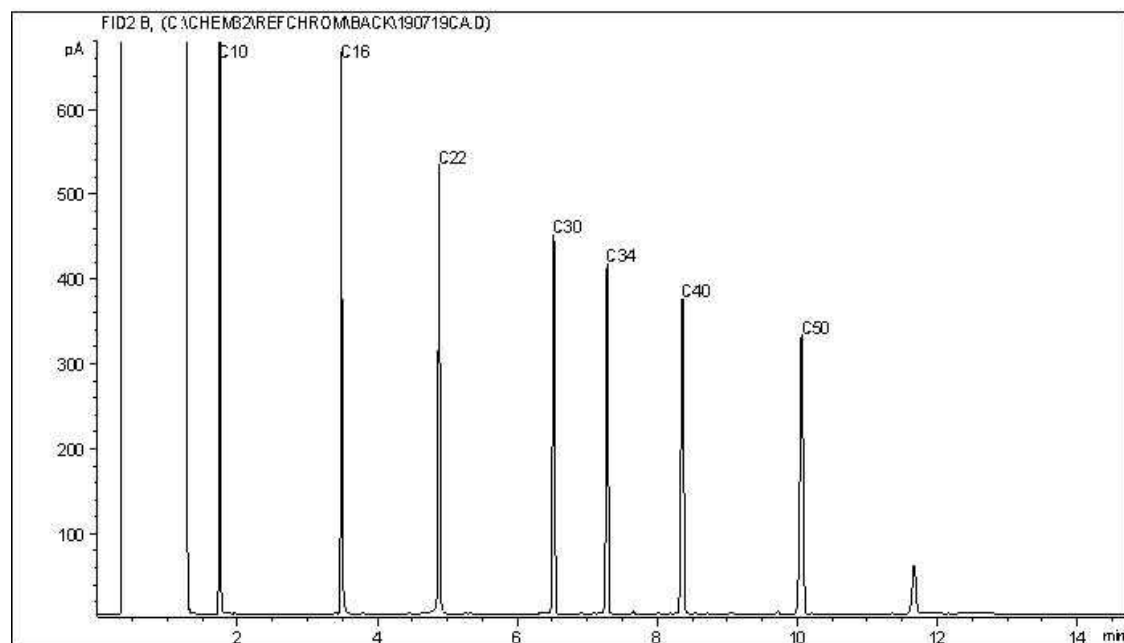
**Note:** This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

# CCME Hydrocarbons (F2-F4 in water) Chromatogram

Instrument: GC7



Carbon Range Distribution - Reference Chromatogram



## TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline:	C4 - C12	Diesel:	C8 - C22
Varsol:	C8 - C12	Lubricating Oils:	C20 - C40
Kerosene:	C7 - C16	Crude Oils:	C3 - C60+

**Note:** This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.